PRODUCTIVITY, POPULATION DENSITY AND RATE OF INCREASE OF AN EXPANDING MERLIN POPULATION

Lynn W. Oliphant and Elizabeth Haug

Abstract - The growth of a newly established population of the Merlin (*Falco columbarius*) in the city of Saskatoon, Saskatchewan, was monitored from 1971 to 1982. Each year nesting pairs were located and their young were counted and banded. The breeding population increased from one pair to sixteen pairs over the twelve year period. The calculated rate of increase (r) of this population was 0.233. Productivity averaged 4.2 young/successful nest and 3.7 young/nest attempt. The density of this population in 1982 was the equivalent of 55.2 pair/100 km².

Man's activities have often been the cause of long term declines in many raptor populations (Newton 1979). In contrast, the urban environment of a few cities on the Canadian Prairie-parkland have provided a new and highly suitable man-made environment for the Merlin (*Falco columbarius*) (Oliphant 1974; Smith 1978). Following a few nestings in the 1960's and early 1970's, the Merlin population in the city of Saskatoon, Saskatchewan, exhibited a dramatic increase. This population expansion has provided a unique opportunity to measure the actual rate of increase (r) of a raptor population in a previously unused environment.

Methods

Surveys of suitable nesting habitat within the city were made each spring. Taped calls of Merlin vocalizations, which were utilized during the last 5 years, greatly reduced the effort needed to detect breeding pairs. Reports of Merlin sightings were investigated and often resulted in discovery of nests. In most years (1974-82) the nests were not climbed until the last half of June when the young were counted and banded.

A "breeding pair" was defined as a pair at a nest site at least into the time of incubation. This criterion was necessary because many pairs relocated in new territories even up to a week or two prior to egg laying. A "successful nest" was one which produced at least one advanced nestling of banding age. The number of young produced was not known for some sites (nest not climbed or

Table 1. Numbers of breeding pairs of Merlins and production of young in Saskatoon from 1971-1982.

Year	No. Breeding Pairs	Minimum No. Young Produced	Estimated No. Young Produced	Average No. Young /Successful Nest	Average No. Young/Nest Attempt
1971	1	3	3	3.0 (1)	3.0
1972	2	5	5	5.0 (1)	2.5
1973	4	4	8*	4.0 (1)	2.0*
1974	2	9	9	4.5 (2)	4.5
1975	3	14	14	4.7 (3)	4.7
1976	5	15	19*	3.8 (4)	3.8*
1977	6	22	22	4.4 (5)	3.7
1978	7	30	30	4.3 (7)	4.3
1979	10	37	37	4.1 (9)	3.7
1980	12	40	40	4.0 (10)	3.3
1981	14	57	61*	4.4 (13)	4.4*
1982	16	50	54*	4.2 (12)	3.4*
Totals Or $\bar{X}$ ± SE	82	286	302	4.2 ± 0.03 (n = 68)	3.7 ±0.07 (n = 82)

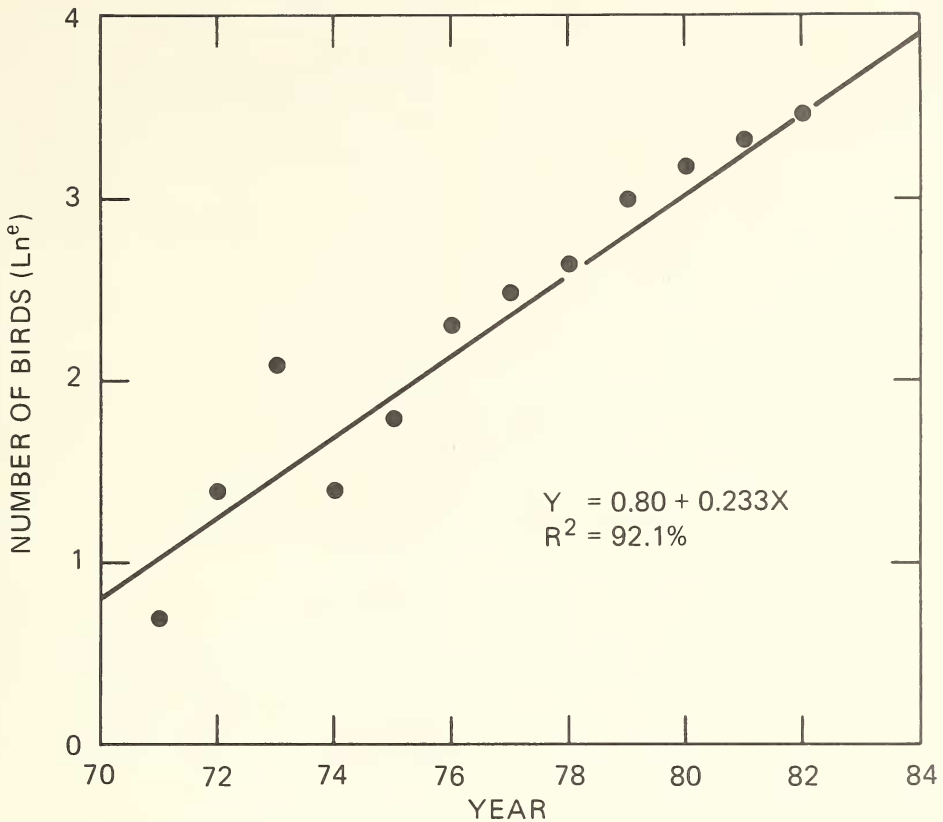*Productivity of one nest estimated as described in Methods section.

Figure 1. Growth of breeding population of Merlins in Saskatoon from 1971 to 1982.

number of young fledged unknown). Production at these sites was estimated by assuming a successful nest produced young equal to the average of all successful nests for that year and a nest with unknown outcome produced young equal to the average of all nests (successful and unsuccessful) for that year.

The actual rate of increase (r) per year of the breeding population was estimated by taking the regression coefficient of $\log_e$ of the number of breeding birds versus year (Caughley and Birch 1971). Analysis of variance was used to test the significance of the regression coefficient.

Results

Prior to 1971 there were 3 Merlin nest records for Saskatoon (1963, 1965 and 1970). Of the 82 known nestings between 1971 and 1982, 71 were successful, 10 failed and the outcome of one nest was unknown. All of the nest sites were in old American Crow (*Corvus brachyrhynchos*) or Black-billed Magpie (*Pica pica*) nests which, with three exceptions, were in large spruce (*Picea* sp.) trees. Table 1 summarizes the numbers of pairs and production of young from 1971-82.

The growth of the breeding population is shown in Figure 1. Other than a decline in 1974, there has been a steady exponential growth over the study period. Regression analysis revealed a rate of increase (r) per year of 0.233 ± 0.022. This linear relationship was highly significant ($F = 116.9$; df = 1, 10; $P < 0.001$) and represents a 26% increase in the breeding population per year.

Although Saskatoon has a total area of 122 km², only the older parts of the city have mature trees offering suitable nesting habitat for Merlins. All of the nest sites (1971-82) were located within a 35 km² core area. In 1982 all 16 pair nested within a 29 km² area. The distance of each 1982 nest site to the nearest adjacent nest site averaged 1.2 km and varied from 0.7 km to 2.3 km.

DISCUSSION

Several factors contribute to making the urban environment of Saskatoon a suitable nesting habitat for the Merlin. A primary factor is the presence of spruce trees which were planted early in the history of the city. As these trees matured they provided suitable nesting habitat for Crows and Black-billed Magpies. Houston (1977) has documented a major influx of these two species into Saskatoon between 1968 and 1972. Until the large stick nests of these corvids were present there were no suitable nesting sites for Merlins which, like other falcons, do not build their own nests.

Another important factor is prey availability. The large urban population of House Sparrows (*Passer domesticus*) provides an abundant prey base heavily utilized by the Merlins (Oliphant 1974; Oliphant and McTaggert 1977). Prey density is probably the most important factor responsible for the current high-breeding density of the Merlin.

A third factor is the proximity of the South Saskatchewan River which runs through the middle of the city. The urban population was most probably derived from the Merlins that occur naturally along the major river systems on the prairies (Oliphant and Thompson 1978; Houston and Schmidt 1981).

Nesting habitat, prey availability and intraspecific competition do not appear to be limiting population growth in Saskatoon at this time. Given these conditions, the calculated rate of increase (r) of this population should approximate the maximum rate of increase (r max) for this situation (Caughley and Birch 1971). This assumes that the population is closed (no ingress or egress). Although this assumption is certainly not valid in the strictest sense, we believe that the majority of birds nesting in the city were indeed fledged from city nests.

Opportunities to estimate the capacity for increase of a wild raptor population are rare. Ratcliffe (1980) describes the decline and resurgence of the Peregrine Falcon (*Falco peregrinus*) in Britain first due to shooting and secondly to pesticides. Rates of increase of the population were not calculated, however.

The Merlins of Saskatoon have already achieved the highest recorded nesting density for this species. The overall breeding density for 1982 was equal to 55.2 pairs/100 km². The densest group of nests was a group of 5 nests contained within 1.3 km² (384.6 pairs/100 km²). Newton et al. (1978) reported maximum Merlin densities of 10 and 13 pairs/ km² in two study areas in northern Britain. The closest nestings they recorded were 3 pairs at the corners of a triangle 1.0 - 1.1 km apart. This is very similar to the *average* distance between nearest neighbors in the 1982 Saskatoon population. In Wales (Williams 1981) the highest Merlin density recorded was 9 pairs in 35 km² (25.7 pairs/100 km²) with 7 of these pairs found within 6 km² (116.7 pairs/100 km²).

This high density in Saskatoon far exceeds recorded non-urban density on the Canadian prairies. During a population study of Ferruginous Hawks (*Buteo regalis*) in southern Alberta, a minimum Merlin nesting density of only 1.9 pairs/ 100 km² was recorded (Schmutz 1982). In limited areas of good habitat, however, non-urban Merlin densities may be higher and occasionally pairs may nest less than 1 km apart (A. Schmidt, pers. comm.)

LITERATURE CITED

CAUGHLEY, G. AND L.C. BIRCH. 1971. Rate of increase. *J. Wildl. Mgmt.* 35:658-663.

HOUSTON, C.S. 1977. Changing patterns of the Corvidae on the prairies. *Blue Jay* 35:149-156.

HOUSTON, C.S. AND A. SCHMIDT. 1981. History of Richardson's Merlin in Saskatchewan. *Blue Jay* 39:30-37.

NEWTON, I., E.R. MEEK AND B. LITTLE. 1978. Breeding ecology of the Merlin in Northumberland. *Brit. Birds* 71:376-398.

NEWTON, I. 1979. Population ecology of raptors. Buteo Books, S. Dakota. 399 pp.

OLIPHANT, L.W. 1974. Merlins - The Saskatoon falcons. *Blue Jay* 32:140-147.

OLIPHANT, L.W. AND S. MCTAGGERT. 1977. Prey species utilized by urban nesting Merlins. *Can. Field-Nat.* 91:280-286,

OLIPHANT, L.W. AND W.J.P. THOMPSON. 1979. Recent breeding success of Richardson's Merlin in Saskatchewan. *Raptor Res.* 12:35-39.

SCHMUTZ, J.K. 1982. An estimate of Ferruginous Hawks in Alberta and the relationship between their density and land use. Unpublished report for the Fish and Wildlife Division of Alberta Energy and Natural Resources.

Smith, A.R. 1978. The Merlins of Edmonton. *Alberta Naturalist* 8:188-191.

Williams, G.A. 1981. The Merlin in Wales: breeding numbers, habitat and success. *Brit. Birds* 74:205-214.

Department of Veterinary Anatomy, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon, Saskatchewan, S7N OWO CANADA. Address of second author: Department of Biology, University of Saskatchewan, Saskatoon, Saskatchewan, S7N OWO CANADA.